

LAURALES

The Laurales are described by STEVENS *loc. cit.* as comprising seven families, 91 genera, 2858 species. The old Monimiaceae was polyphyletic and the Atherospermataceae (in New Guinea) and Siparunaceae (outside tropical Asia) have been segregated in their own families.

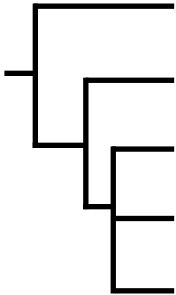
With regard to number of taxa and ecological importance, the order can be seen as the Lauraceae and a few

associated small families. All are woody plants, chiefly of the tropics and subtropics.

While the overall circumscriptions and internal structure of the order has improved through molecular studies^{1,2}, uncertainty remains with respect to the relationship of the several families. Of particular interest to students of phylogeny is what appears to be a striking difference between morphological and molecular evolution among the three core families of Hernandiaceae, Monimiaceae and Lauraceae. The phylogeny below is based on the two cited studies.

¹Renner, S. 1999. American Journal of Botany. 86: 1301–1315.
²Renner, S, *et al.* 2000. International Journal of Plant Science. 161: 109–119.

Phylogeny of Laurales

	Family	Diversity & Distribution	Trees of Tropical Asia
	Calycanthaceae	5/11, N America, China, NE Australia.	0.
	Siparunaceae, Gomortegaceae, Atherospermataceae	Atherospermataceae (6/16) in New Guinea and eastward, otherwise 3/75 mostly tropical America.	0.
	Monimiaceae	22/200, pantropical.	3/12, although only 2 species representing 2 genera are common.
	Hernandiaceae	5/55, littoral, pantropical.	2/2.
	Lauraceae	50/2500, warm global.	About 500 species in 17 genera.



MAGNOLIIDS: LAURALES

MONIMIACEAE

NAME: From the genus *Monimia*, comprising three species, of Reunion and Mauritius Islands.

OVERVIEW: The Monimiaceae are a small family of 22 genera and 200 species, a few species found in all tropical continents with the highest diversity in Australia and New Guinea. For most of tropical Asia, we find only two species, *Matthaea sancta* and *Kibara coriacea*. Both are small trees, sparse in abundance but found consistently in lowland forests of the Sundaic Region and eastward.

The family shares with Lauraceae and Hernandiaceae a single ovule in each carpel positioned near the apex, a trait that distinguishes it from those genera associated with *Siparuna* (formerly in a broad Monimiaceae) where the ovule is basal. Whereas the flowers of Lauraceae have two whorls of usually three tepals each, the Monimiaceae have four to six (-eight) tepals in two whorls, or in two extra-Asian genera, 10 to 20 spirally arranged tepals.

Also, whereas both the Lauraceae (with tetrasporangiate anthers) and the Hernandiaceae (with bisporangiate anthers) share the peculiar opening by flaps, in the Monimiaceae the anthers open by slits. The two genera in tropical Asia are distinguished by the anther: in *Kibara* six to nine stamens in two series, anthers opening by one longitudinal slit; in *Matthaea*, stamens four in one series, anthers opening by two longitudinal slits.

In our species the mature carpel is non-fleshy, indehiscent, clustered as a head of drupes or nuts. Field studies of floral sexuality are wanting (monoecious or dioecious). Elsewhere, these genera are pollinated by flies and beetles. *Steganthera hospitans* in New Guinea bears twigs inhabited by ants.

The two genera can be recognized in the field as small evergreen trees (rarely lianas to the east), the leaves simple opposite, leathery, without stipules, the twig is terete and the node is clean but somewhat flattened. They are without exudate, but somewhat resinous and odorous, weakly gland-dotted, pinnately nerved, and in out species the margin bears ragged, irregular and distant teeth, but haphazardly so such that some leaves on a twig are

toothed and others entire. The blade accumulates aluminium and dries yellow.

Both of our common species are fairly widespread small trees of the forest understory. They show up as widely scattered individuals of small stature, never much over 5 cm DBH, and slow-growing. The flesh covered fruit are blue or black at maturity.

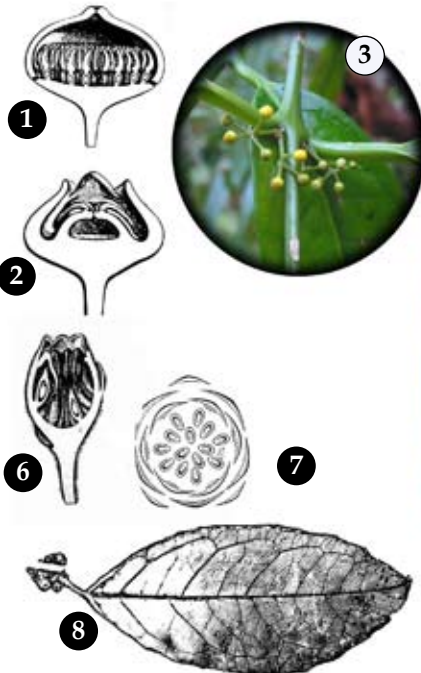
MATTHAEA. [Commemorates Matteo de S. Giuseppe, d. 1691, Italian Missionary and Botanist of India]. *Matthaea* is usually treated as six closely related species. *Matthaea sancta* is widespread and common in tropical Asia, while eastward, more species are named with five species claimed by the Philippines, although all are similar.

KIBARA. [After a Sundanese plant name]. Perhaps 40 species, east of our region, with the small forest tree, *Kibara coriacea*, found widely in the Sundaic Region and the Philippines.



Above, *Kibara blumei*; Below, *Matthaea sancta*. (Adapted from BLUME loc. cit.)

Monimiaceae



1-5, *Matthaea heterophylla*; 1, staminate flower; 2, pistillate flower; 3, inflorescence, axillary in opposite leaves; 4, toothed opposite leaves, looped nerves; 5, stalked monocarps; 6-8, *Kibara coriacea*; 6, pistillate flower, 7, transverse floral diagram; 8, drawing from Sarawak voucher specimen, opposite leaves, toothed margin. (1-2, 5-6 BAILLON loc. cit.; photographs 3-5, © Leonardo L. Co).

MAGNOLIIDS: LAURALES

HERNANDIACEAE

NAME: The name is from *Hernandia*, as below. Although the individual species are well known, there are no local names for the family as a whole.

OVERVIEW: A small family of five genera and 55 species, especially rich in Madagascar with a few widespread species of the ocean shore allowing a technical claim of pantropical distribution. The family bears small flowers Lauralean in form but distinct in inferior ovary, indehiscent fruit, and palmately nerved leaf blade. Within our region we find only two genera each with a single species.

HERNANDIA. [Commemorates Spanish botanist of Mexico F. Hernandez, d. 1587.] A genus of 24 species, chiefly in the Americas, with one species in Asia from Sri Lanka to Andaman Islands, Malaya, Borneo to the Pacific: *H. nymphaeifolia*. Common synonyms including *H. ovigera* and *H. peltata*. This is a characteristic tree of the sandy and rocky seashores typically found together with *Terminalia catappa*, *Calophyllum inophyllum* and *Barringtonia asiatica*. An evergreen tree with weak

wood from a crooked and branched bole, sometimes 20 m tall. The peltate leaf is recognizable. Even more so are the diagnostic fruits that bear a white fleshy lampshade around a black seed. The flowers are unisexual, in threes, the central flower is pistillate while the two lateral flowers are staminate.

The most common Malay name is probably *buah keras laut*, the sea *Aleurites* (Euphorbiaceae) and the seed is used similarly as a source of lamp oil.

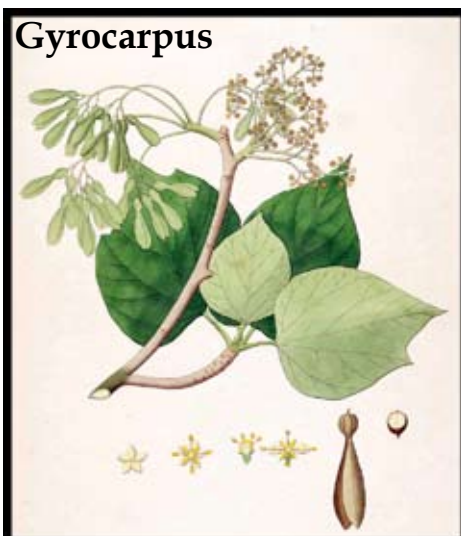
GYROCARPUS. [Greek, ringed-fruit, in reference to the folded cotyledons.] A genus of three species, but in Asia only the pantropical *Gyrocarpus americanus*. A small deciduous tree of seashores and inland seasonal hill forests. It bears a pale bark, light wood with a strong fetid odor. At least the youngest twigs and leaves are softly hairy. The leaves are palmately nerved, but in outline they vary among populations from entire and ovate to lobed. The flowers are arranged in a large terminal inflorescence. The flowers are either staminate (most flowers) that bear four-seven perianth segments and four stamens alternating with staminodes, or bisexual with four perianth segments. The fruit is odd among the Laurales in that it is winged and wind dispersed. It superficially looks like a dipterocarp.

Hernandia



Hernandia nymphaeifolia, upper right, flower; lower right, leaf and fruit; upper left, LS of inflated fruit. (Photographs © Ulysses Ferreras; drawing from BAILLON *loc. cit.*)

Gyrocarpus



Gyrocarpus americana, from ROXBURGH *loc. cit.*

LAURACEAE

NAME: From the genus *Laurus*, classical name of *Laurus nobilis*, the ancient laurel. In Malay, *medang* is generally used for both tree and timber, sometimes with additional adjectival names or even singular names for those species economically exploited or otherwise well known. In English, it may be called the cinnamon or avocado or laurel family.

OVERVIEW: The Lauraceae are diverse and abundant tropical trees with very uncertain numbers of taxa. Estimates of species numbers range from 2000 to 4000, these arranged in genera that number from 30 to 55. Lauraceae are diverse and abundant in all tropical lands with a few abundant species in extra-tropical latitudes north and south. The laurels are typically among the five most important families with regard to number of species in the lowland equatorial forests of Asia; their abundance increases with elevation and are typically codominant with the Fagaceae at around 1000 m. In lowland forests, the number of large trees is not so high, but the number of small trees is high enough to rank the family among the five most abundant.

Uniform features of the family include the simple elliptic leaves without stipules, chemical composition, and in the small regular flowers with concave receptacle that places the perianth about the circumference of the gynoeceum. The anthers, which dehisce by distinctive flaps, are the most obvious diagnostic feature of the family. The ovary typically bears a solitary descending ovule (anatropous with the micropyle pointing upward); the indehiscent fruit is often subtended by swollen and colored floral parts that might be derived from the stalk, hypanthium, tepals or combination of parts. The fruit bears a single large seed that lacks endosperm.

Variation in the details of floral form is relatively great and terribly discordant among the many species. In a review of classification schemes in the Lauraceae¹, the authors found that most of the conflict among systems derives from a varying emphasis on the number of stamens, whether there are two or four cells in the anthers, and the degree to which the ovary is embedded in tissue of the floral stalk. They suggest that patterns of inflorescence development provides a better overall scheme. Phylogenetic studies of molecular data reinforce those

conclusions^{2,3,4,5,6}. Of particular note are the conclusions of Jie Li⁵, "These results suggest that the use of two- versus four-celled anthers for Laureae generic delimitation has resulted in polyphyletic or paraphyletic genera, and the character of dimerous versus trimerous flowers is of only limited phylogenetic value," and that "... virtually all traditional morphological characteristics show high levels of homoplasy and/or reversal." Those conclusions certainly point toward the current disposition toward large genera. Consequently, I freely accept established synonymy whenever available and reduce the Asian woody Lauraceae to 17 genera arranged in five informal groups. The following generic names appear routinely in regional literature and are treated in synonymy here: *Machilus*=*Persea*, *Potoxylon*=*Eusideroxylon*, *Nothaphoebe* is variously among the *Persea* group, and *Hexapora* in *Beilschmiedia*. We might reduce a few other genera if the conclusion cited above were followed strictly: *Potameia* within *Beilschmiedia*, and perhaps *Aleodaphne* within *Debaasia*.

It is not difficult to recognize the family Lauraceae from vegetative characters once you are familiar with

FIELD RECOGNITION: LAURACEAE

Recognized to family, first, by the combined absence of notable features: lacking stipules, pulvini, toothed margins, obvious laminar glands.

In species of the wet lowland forest, the bark is often thin, sometimes pock-marked or flaking in sheets, but usually neither thick nor furrowed. In dry seasonal places, thicker bark with shallow fissures is more common. The wood is usually recognizable as yellow to white, often granular, oily, resinous and odorous.

Leaf stalk often long, sinuous and thin near the blade while thicker near the twig, but not pulvinate; it is articulate with the twig, the node is clean, without scars or swellings; sometimes a white bark forms on the lowermost portion of the stalk.

The twig bark does not peel easily and is not fibrous.

The blade is elliptic, entire, glossy, resinous, and with some odor. In a great many species, the venation of the blade is uniformly finely boxed-reticulate, and lower leaf surface is whitish or blue-green.

The blades often dry a glaucous shade of pale blue or red.

Leaf arrangement is opposite, whorled, alternate in a plane, irregularly spaced or clustered at the tips, the differences roughly correspond with genera.

Hairs, if present, are always simple, often appressed.

FIELD CONFUSION

The Fagaceae are often equally abundant in oak-laurel associations; they differ in the presence of stipules, grooved and furrowed twigs, resinous-tanniferous blades. Some *Quercus* can look very much like *Actinodaphne*, but note that in *Quercus* a few marginal teeth are almost always present. The bark and wood of the two families are entirely different.

In the Annonaceae the leaf stalk is not tapered from base to apex, the twig bark peels easily to reveal a fishnet pattern.

Other families with opposite leaves can be distinguished from those *Litsea* with opposite leaves by the presence of some detail of the node: stipules or a scar in Rubiaceae, or by a toothed leaf margin in many other families.

Trees with 3-nerved leaf blades are sometimes mistaken as Lauraceae: *Anisophyllea*, *Myrtaceae*, *Melastomataceae*, *Coccoloba*.

¹van der Werff, H. *et al.* 1996. *Annals of the Missouri Botanical Garden* 83: 409–418.

²Chanderbali, A. *et al.* 2001. *Annals of the Missouri Botanical Garden* 88: 104–134.

³Li, J. *et al.* 2004. *Journal of Plant Systematics and Evolution*. 246: 19–34.

⁴Li, L. *et al.* 2007. *Plant Systematics and Evolution*. 269: 203–221.

⁵Li, J. *et al.* 2008. *Annals of the Missouri Botanical Garden*. 95: 580–599.

⁶Fijridiyanto, I. *et al.* 2009. *Journal of Plant Research*. 122: 283–298.

⁷Li, S. *et al.* 2008. *Flora of China*. 7: 102–254.

Genera of Lauraceae as Trees in Tropical Asia
Arranged in Phylogenetic Groups

		GENUS	DIVERSITY	SPOT CHARACTERS
Neocinnamomum Group	The inflorescence is an often dense panicle of multi-flowered cymes, not strictly 3-flowered and with bracts on the flower stalk that vary in number and position.	<i>Neocinnamomum</i>	7/7, China to Mainland SE Asia, high mountains	Small tree, uncommon, 4 celled anther, lvs 3-nerved, alternate,
		<i>Caryodaphnopsis</i>	7/15, Asia America, rare	Lvs 3-nerved, in upturned clusters,
		<i>Cryptocarya</i>	50/250?, pantropical, common, abundant species-rich in TA	Most species with blades alternate in a plane, pinnate nerved, somewhat blistered above.
		<i>Eusideroxylon</i>	2/2. Sundaic (not Malaya), common and abundant but in restricted habitat.	Large tree, large spirally arranged, pinnate nerved;
		<i>Beilschmiedia</i>	40/200 ?, Asia-America, common, abundant, species-rich.	Some large trees, mostly pinnate-nerved, some opposite decussate, some loosely in a plane,
Cryptocarya Group	The inflorescence is an often dense panicle of multi-flowered cymes, not strictly 3-flowered and with bracts on the flower stalk that vary in number and position.	<i>Potameia</i>	21, chiefly Madagascar, with 1 each Hainan, India, Bhutan	Likely not in tropical Asia, but look for Beilschmiedia with dimerous flowers.
		<i>Endiandra</i>	20/100 ?, China, Asian tropics and Australia, a few common, consistent.	Some large trees, most of our species with distinctive venation: wide boxed reticulate, even and raised,
		<i>Cinnamomum</i>	30/200?, Asian-American but uncertain relation to American <i>Persea</i> , common, abundant, species-rich.	Most Asian species opposite 3-nerved leaves with spicy odor; a few common species with pinnate alternate leaves (<i>C. porrectum</i>) .
Asian Cinnamomum Group	The inflorescence is a raceme, often condensed and protected by overlapping bracts, with a bract below each flower; among our trees, most of the species with unisexual flowers are here.	<i>Litsea</i>	100/200, Asia to Australia, a few in S America, common, abundant, species-rich.	A few large trees, many small, many with spiral upturned clusters; some as small trees, leaves opposite pinnate-nerved; a few leaves loosely in a plane; 4-celled anther.
		<i>Actinodaphne</i>	50/80, Asia, Australia, common, abundant, species-rich.	Mostly small trees, leaves in tiered whorls, often glaucous below.
		<i>Neolitsea</i>	15/85, India to China, Mainland SE Asia, less so eastward.	Large trees, leaves 3-nerved, spiral.
		<i>Lindera</i>	40/100, Asia to Australia, E N America, poor in equ. lowlands, common and abundant in mountains.	Differ from <i>Litsea</i> in 2-celled anther, leaves more uniformly pinnate nerved in upturned clusters.
		<i>Cinnadenia</i>	2/2, Mainland SE Asia, uncommon.	Inflorescencerecence with bracts.
Litsea Group	The inflorescence is a raceme, often condensed and protected by overlapping bracts, with a bract below each flower; among our trees, most of the species with unisexual flowers are here.	<i>Dehaasia</i>	20/35, China to Borneo and Philippines.	Often large trees, leaves in upturned spiral clusters, twigs and leaf stalk contrasting color; 4-celled anthers.
		<i>Alseodaphne</i>	35/50, Asia .	As in <i>Dehaasia</i> but leaves loosely in a plane, 2-celled anthers.
		<i>Phoebe</i>	20/80, E Asia to tropics.	Tepals persistent and clasping base of fruit.
		<i>Persea</i> (including <i>Machilus</i>)	150, Asian-American.	Tepals spreading or deciduous in fruit,
Persea Group	The inflorescence is an often long-talked panicle of cymes, each of the terminal and two opposite flowers, each with two bracts at mid stalk. Rich in Neotropical genera and species.)			

the range of variation in the venation and arrangement of the leaves. The main nerves can be either pinnate or strongly three-nerved while the leaves are displayed in almost every possible arrangement: strictly opposite (*Cinnamomum*, *Litsea*), alternate in a plane (*Cryptocarya*), in upturned spiral clusters (*Phoebe*, *Dehaasia* and others), and in strict tiered whorls with scale leaves (*Actinodaphne*).

The recognition of genera is another matter. The main problem is that even though some genera have a core of very similar and easily recognized species, at the periphery lie species that are included by floral features but otherwise overlap with related genera. Consequently, no genus can be diagnosed by a decisive synapomorphy. So clear a feature as the three-nerved leaf blade is not a sure indication of the genus. It is widely in *Cinnamomum*, but not uniformly so since a few Asian species of *Cinnamomum* have pinnately-nerved leaves, while three-nerved blades are also typical of *Caryodaphnopsis*, *Neocinnamomum*, and *Neolisea*. Furthermore, three-nerved blades occur rarely in genera that are typically pinnately-nerved such as *Cryptocarya*, *Litsea* and *Actinodaphne*.

The first phylogenetic group includes two fairly uncommon genera of trees found in strongly dry seasonal mountains: *Neocinnamomum* and *Caryodaphnopsis*. The second clade consists of the allies of *Cryptocarya*, which can be divided into those in which the fruit is embedded in a fleshy cupule (*Cryptocarya* and the *belian* tree, *Eusideroxylon*) and those in which the ovary is superior (*Beilschmiedia*, *Endiandra*, and *Potameia*).

The third clade is a great band of species-rich Neotropical genera allied with *Cinnamomum*, our only representative. The fourth clade is the *Litsea* Group, each genus of which has a monophyletic core of species, and yet, when strictly defined on morphological details (e.g., two vs four anther sacs), each genus appears polyphyletic. The fifth clade is the *Persea* Group.

The ecology of Lauraceae is poorly known, especially with regard to those physiological traits that allow these trees to dominate at mid-montane environments. In a 7.5 ha plot at 1000 m elevation on Doi Inthanon, Thailand, the Lauraceae were the most species-rich and most abundant of families, represented by 20 species in 10 genera, and accounting for 18% of the total basal area. At 500 m elevation in Huai Kha Khaeng, Thailand, Lauraceae were also species-rich and abundant, with 11 species, and was the third most abundant family among trees over 30 cm DBH. Although the family is not so numerous among the large trees of the lowland equatorial forests, laurels can be even more species-rich than in the mountains. We found 52 species at Pasoh, Malaya and 75 at Lambir, Sarawak.

Knowledge of reproductive ecology in Lauraceae is especially patchy. While the flowers are bisexual in form, temporal unisexuality is well-demonstrated in the commercial avocado. The flowers of avocado open twice,

once in a female phase, once in a male phase. When it first blooms, it is in a female stage, receptive to pollen. On the following day, the flower opens again and functions as a male and pollen is released. Furthermore, avocados are of two breeding types. Trees of "Type A" bloom in a female-stage from the morning till noon, and then enter the male-stage on the afternoon of the following day. "Type B" trees bear female-stage flowers in the afternoon of the first day and male-stage flowers the following morning. Pollen is transferred by honey-bees with nectar as a reward. A similar pattern of flowering may be fairly general among Lauraceae; however, with thousands of species, numerous variations are to be expected. Cryptic dioecy is suspected among the small trees of the understory with bisexual flowers.

Laurels, with their flesh-covered one-seeded fruits, are a key food resource for the wildlife of tropical forests, perhaps second only to figs in importance. The dominance of the family at lower and mid montane elevations, together with a predictable fruit production, may be the key factor that drives altitudinal migration among birds⁹.

The most economically important Lauraceae in Asia include the avocado (native to the Neotropics), commercial cinnamon, and a few widely planted ornamentals trees such as *Cinnamomum iners*. The timber of a few individual species is important, most famously, *belian* in Borneo. Otherwise, the timber is traded in bulk under the family name *medang*.

The taxonomy of individual species will likely remain difficult for a long time. What is most needed today is a more intimate knowledge of the living trees for certain select species. Continuous observation on selected trees would yield a wealth of new information on reproduction, pollination, phenology, floral development - and most critically - on the morphology and development of the inflorescence and its branches. Two conventional keys to most of our genera can be found in the family treatement of the Flora of China⁷.

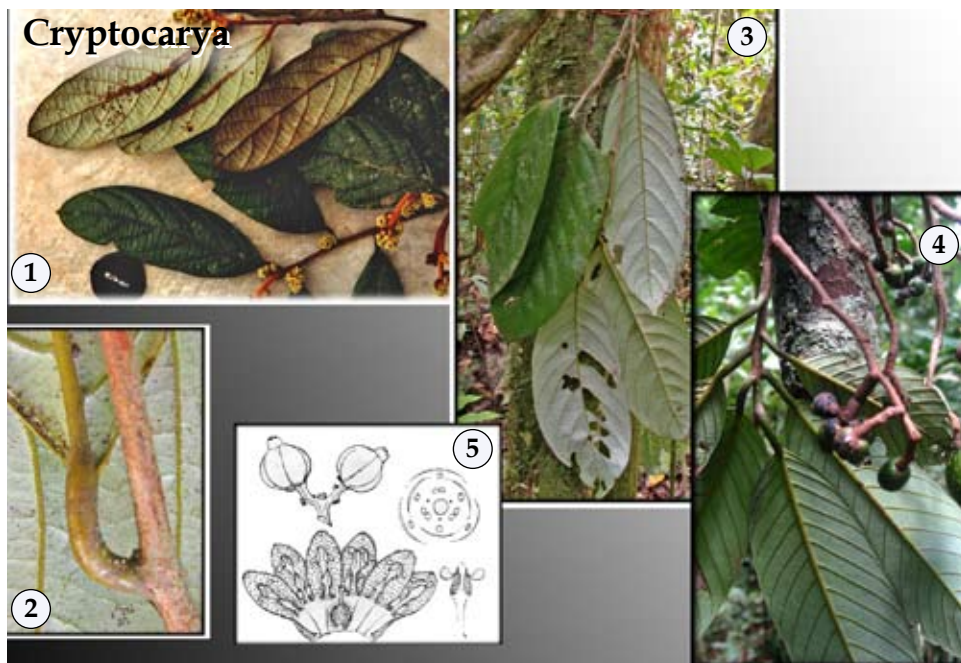
☞ - *Neocinnamomum* Group - ☞

NEOCINNAMOMUM. [Greek, near *Cinnamomum*.] About seven species from southern China to Thailand and Vietnam, sparsely in Sumatra, not in Malaya. These are small trees chiefly in mid to high elevations. With their strongly three-nerved blades, these look like a cinnamon with alternately arranged leaves. The flowers are bisexual, anthers four-celled, flowers in fascicles arranged along a branched inflorescence or sessile in leaf axils; tepals to two mm long. The most commonly encountered species may be *Neocinnamomum caudatum*. (Not illustrated.)

CARYODAPHNOPSIS. [Greek, for a seed like *Daphne*.] A small, peculiar genus of seven species in Asia and eight in America. When in fruit, these trees look like an avocado with leaves of a cinnamon, opposite and with three-nerved blades. However, molecular data

⁸Sri-Ngernyung, K, *et al.* 2003. Journal Ecological Research. 18: 1-14.

⁹Kimura, K, *et al.* 2001. Journal of Tropical Ecology. 17: 833-858.



Cryptocarya. A species-rich genus, and many appear similar to one another. 1, *C. crassinervia*, Sarawak, typical of the genus are the alternately arranged short-stalked leaves, pinnately nerved, billeted or blistered above, often glaucous below; 2-3, *C. kurzii*, Malaya; 2, the leaf stalk, besides being short, tends to be uniform in width rather than tapered toward the apex as is typical of most Lauraceae; 3, the leaf blade here is glaucous below, but less blistered; 4, *C. cagayanensis*, Philippines, the leaf stalk long enough to show some tapering; 5, floral drawing and diagram, from WIGHT *loc. cit.* (Photograph 4, © Leonardo L. Co.)

removes these trees far from *Persea*. The flowers are bisexual, the tepals strongly unequal, the outer three much smaller than inner three. Most of the scattered collections from tropical Asia (not Sundaic) are treated as a widespread species, *Caryodaphnopsis tonkinensis*, including Mainland SE Asia, with *C. laotica* in Laos. Elmer's *Persea pyriformis* of the Philippines (without a published name under *Caryodaphnopsis*) seems distinct; it is from Mindanao, with later collections from Samar, with large yellow pear-shaped fruit from long pendent stalks. (Not illustrated.)

☞ - *Cryptocarya* Group - ☞

A somewhat surprising group, but defined on inflorescence structure and molecular evidence; poor in the Neotropics, especially species-rich in Asia and also Australia, with many endemic species.

CRYPTOCARYA. [Greek, hidden-seed, reference to the perianth tube closing over the fruit.] The upward estimate of 250 species seems high, roughly pantropical but absent from most of Africa. About 80 in tropical Asia, 19 in Malaya, but about 32 in the Philippines. Most species are narrowly distributed, more than a few known only from the type, but at least some are locally abundant, and they are collectively conspicuous understory trees of the lowland and mountain forests; possibly a significant food source for understory birds. Most spe-

Eusideroxylon



Eusideroxylon malagangai, Sarawak, the trunk red, often irregular, the leaves large, glabrous, ordinary Lauraceae.

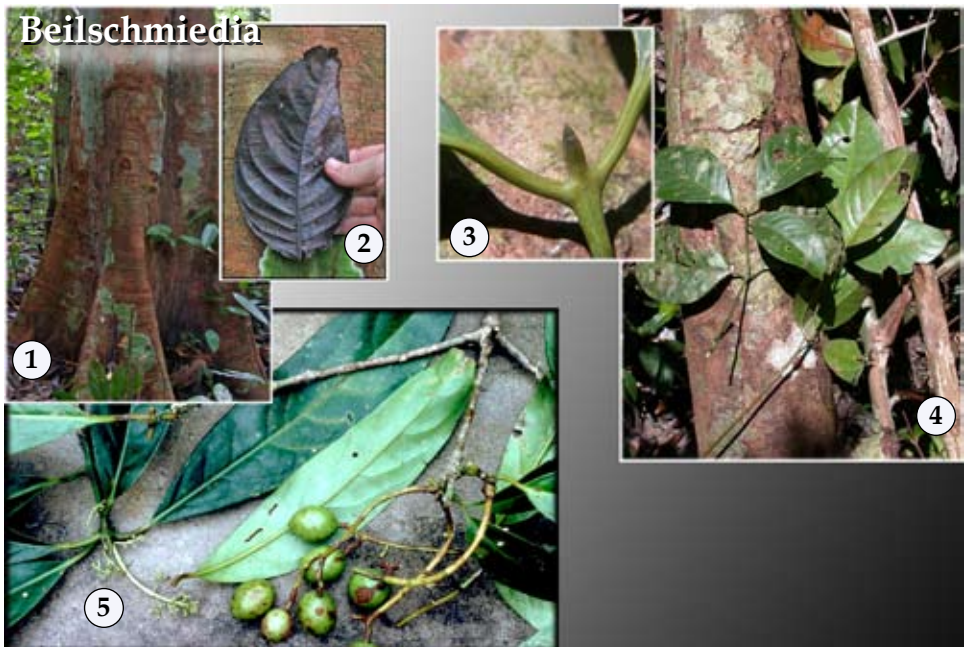
cies have alternate leaves held in a plane on horizontal twigs, unlike the upturned loose clusters of other Laurels. The blade is about 10-20 cm long, elliptic, with a raised midrib; the lower leaf surface is often a glaucous blue-green. The inflorescence is usually axillary to the foliage leaves near the twig tips. Bisexual flowers, nine fertile stamens in three whorls; filaments of 1st and 2nd whorls glandless with anthers introrse, those of 3rd whorl each with two glands at base, anthers extrorse. The ovary is enveloped by a fleshy covering derived from the perianth tube.

EUSIDEROXYLON. [Greek, implies that this is the true ironwood.] A genus of two species found in Borneo, eastern Sumatra, Bangka, S Philippines (*E. zwageri* in Tawi-Tawi). Local names include *belian*, or sometimes *tulian* or *tambulian*. The preferred timber name is *ulin*. The genus shares with *Cryptocarya* an ovary which is embedded in the hypanthium. However, here the leaves are upturned in loose spiral clusters. A student may not recognize the leaves at a glance, appearing at first like many other large-leaved laurels. But everyone in Borneo knows the tree, so just get someone to show you an example. Two species are included here, *Eusideroxylon zwageri*, is found all over Borneo; the leaves are very fragile and break up into separate little pieces when rubbed, the wood can be split for shingles, the twigs are round. In the flower, only the third whorl of stamens are fertile. The second species is *E. melagangai*, sometimes in literature in its own genus *Potoxylon*, with nine fertile stamens. It is known in Borneo as *melagangai*, or *belian-*

simpob. It is found to the east and north of Sibuan town in Sarawak; the leaves are fibrous, the veins hold the pieces together when rubbed, the twigs are square, the wood is difficult to make into shingles. The fruit is said to be larger than the other species.

Together, the two species contribute the most valuable timber of Borneo, and as might be expected they have been exhaustively exploited. The trees prefer moderately rich soils and were one of the trees used in identify potentially good agricultural land. Over most of the range, *belian* occurs as scattered individual trees, but in a few places it is gregariously abundant, and forms a nearly mono-specific canopy. These are the so-called *belian*-forests, and, not surprisingly, have been nearly extirpated as a special habitat. Fire is likely a key factor in their development, and fire may hold a partial explanation for why the tree is so widespread in Borneo and east Sumatra, and yet absent from Malaya, where recurrent fires over rich alluvial soils are perhaps less destructive. The British tried to establish plantations of *belian* in Malaya as early as 1888 when thousands of seedlings were brought to Singapore. Although they were unsuccessful, the wood is so valuable that a new attempt would seem sensible.

BEILSCHMIEDIA. [Commemorates CT Beilschmied, d. 1848, German apothecary, author on-plant geography.] 200 species of uncertain taxonomic limits, at least a few species are claimed in all parts of the tropics, S America, Madagascar, and Australia. In tropical Asia, we find perhaps 50 species with 18 in Malaya, 29 in Borneo but only three in the Philippines. (A recent

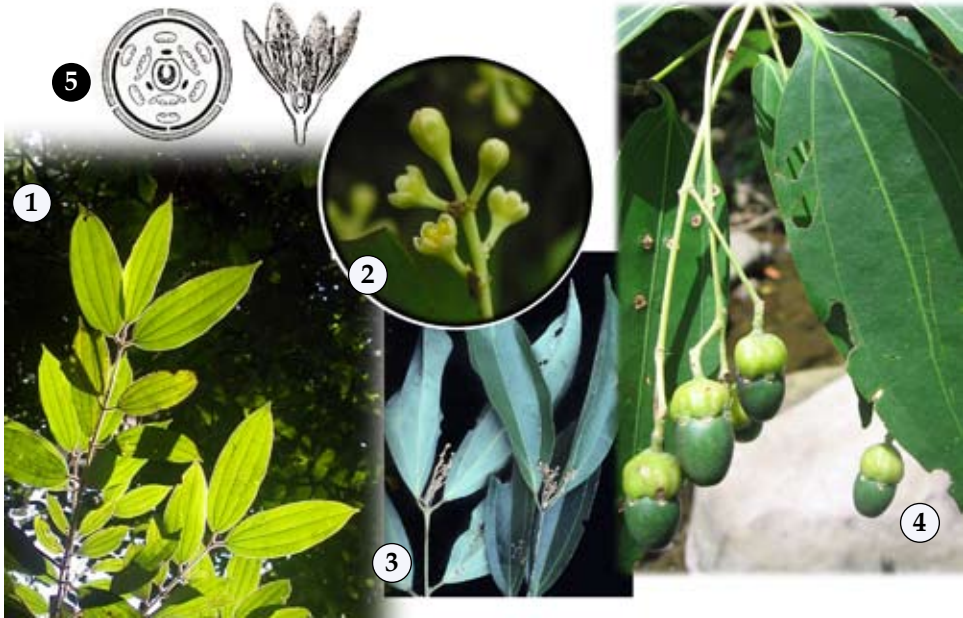


Beilschmiedia. Three species at Pasoh, Malaya; 1-2, *B. madang*, a 63 cm DBH tree, the fallen leaf black, pinnate-nerved; 3-4, *B. lucida*, the leaves roughly opposite, typical of many species in the genus, the node very clean, the apex pointed and somewhat resinous; 5, *B. insignis*, the tree bearing flower and fruit simultaneously.



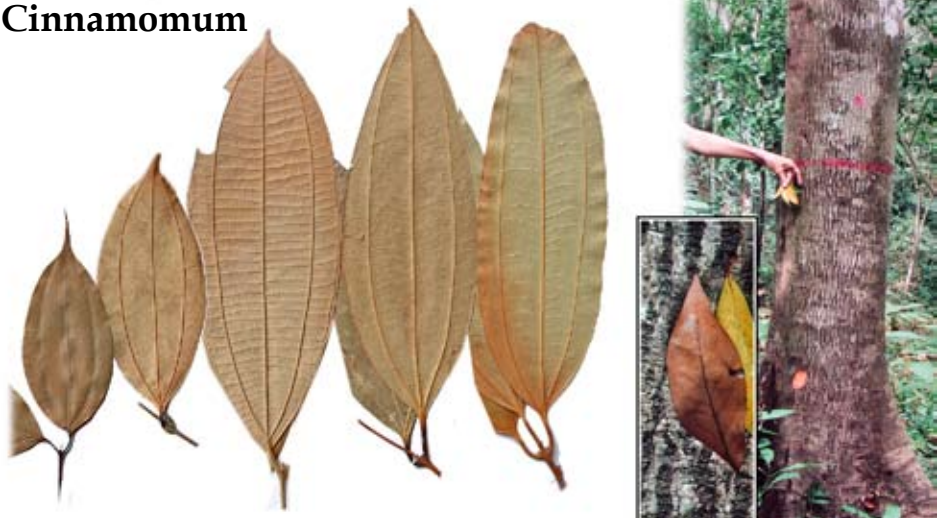
Endiandra clavigera, Sarawak, buttressed tree and associated specimen showing the strong and wide boxed venation, raised on the upper surface.

Cinnamomum



Cinnamomum. 1, *C. mollissimum*, Malaya, soft hairy leaves and intensely fragrant, the leaves strictly opposite, but the final pair often reduced to one and so creating the appearance of a trifoliate tip; 2, flowers of an unidentified *Cinnamomum* from Palali, Philippines; 3, *C. iners*, Malaya, with a typical sparsely flowered terminal inflorescence; 4, *C. mercadoi* from Bataan, Philippines, the fruit large; 5, floral diagram and line drawing of *Cinnamomum*. (2, © Leonardo L. Co; 4, © Ulysses Ferreras; 5 from BAILLON *loc. cit.*)

Cinnamomum



Cinnamomum. Variation among dry leaves of species at Lambir, Sarawak, all are opposite and 3-nerved; from left to right, *C. nitidum*, *C. tabijanum*, *C. javanicum*, *C. crassinervium*, *C. racemosum*; to the right is an example of those species of *Cinnamomum* species with leaves that are both spirally arranged and pinnately veined, *C. porrectum*, common in the mountains of Malaya and of scattered occurrence in Mainland SE Asia, here from Huai Kha Khaeng, Thailand, here showing the bark characteristic of the species.

revision of the Bornean species has done much to clean the nomenclature⁹.) The leaf arrangement varies among species, in some the leaves are in an inexact spiral, but in many others the leaves are opposite in upturned loose clusters, sometimes strictly so, but sometimes clumsily sub-opposite. We can include here the peculiar and poorly known species of Penang Island, Malaya *Beilschmiedia curtisii* (= *Micropora* & *Hexapora*). The characteristic floral features of the genus include flowers with nine two-celled stamens, and fruits that are not covered by the tepals or floral stalk. The perianth is deciduous, rarely persistent at the base of the fruit.

Some species reach large size and are used for timber; however, the Asian species are not so well-known as species elsewhere in the world. The genus includes the bolly-gums of Australia, and *B. tawa* is an important timber tree of North Island in New Zealand. *Beilschmiedia pendula* is a well-known tree of Meso-America, and *B. anay* of Mexico yields the local fruit, *anay*.

POTAMEIA. [Greek, river, in reference to the presumed habitat.] A genus with 19 species in Madagascar, and one each in Hainan, Bhutan and India¹⁰. Basically, a *Beilschmiedia* with two-merous flowers, alternate-spiral leaves, although in *Potameia tirunelvelica* of India the leaves are opposite. Further study may find these trees lie embedded within a broad *Beilschmiedia*. (Not illustrated.)

ENDIANDRA. [Greek, depauperate of stamens.] A genus of 100 species, restricted to Asia, in general from the Mainland SE Asia to the Pacific. There are 10 species in Malaya, more than 12 in Borneo, and two in the Philippines. Australia claims 38 endemic species that yield a valued timber of variegated color. Most species are canopy trees to 40 m tall. In tropical Asia, they are relatively well known by the Malay name *bejubai*. *Endiandra* can be recognized in the field by the prominent raised boxed reticulations on the upper and lower surface of the leaf blade. The flowers bear only a single whorl of three stamens, the anthers two-celled, extrorse, the fruit without a persistent perianth. Again, the genus may lie nested within a broad *Beilschmiedia*.

☪ - *Cinnamomum* Group - ☪

This group within the Lauraceae is rich in genera and species in the Neotropics (*Octandra*, *Nectandra*, etc.); in Asia it is represented by what is probably a distinct clade.

CINNAMOMUM. [Derived from Phoenician words used since ancient times for spices in general, including the ancient cinnamon prescribed by Moses for the Tabernacle, but the name not clearly associated with *Cinnamomum verum* until Roman times.] Uncertain species number, largely owing to the unresolved alliance of the American species under this name, maybe 60 in tropical Asia with 15 in Laos, 22 claimed for Malaya, 21 for the Philippines, mostly narrow endemics. The Sanskrit name *teja* widely applied in Java and elsewhere, but a more common Malay name is simply sweet-wood, *kayu manis*.

⁹Nishida, S. 2001. Acta Phytotaxonomica et Geobotanica. 52: 103-113.

¹⁰Gangopadhyay, M. 2008. Bangladesh Journal of Plant Taxonomy. 15: 89-106.

Cinnamomum is sometimes species-rich in the lowlands, but becomes especially abundant in the montane forests. The individual species differ in the size of the leaves, the details of venation and the presence of indumentum.

Almost of the Asian species bear opposite three-nerved leaves, an open terminal inflorescence and almost always some degree of sharp spine in the leaves. Note that not all laurels with three-nerved blades belong here. The open flowers of *C. burmanii* are well illustrated in THROWER *loc. cit.*

A large number of American tropical species formerly in *Persea*, and with alternate leaves and pinnate venation, were transferred to *Cinnamomum* by Kostermans in 1961. Although the Asian species of *Cinnamomum* formed a strong clade in the cited molecular study, only a few species were sampled and only those with opposite three-nerved leaves. The position of *C. porrectum* is of particular interest.

Cinnamomum camphora is probably native to extra-tropical Japan and China but can be grown in the tropics for ornament or a type of camphor distinguished from camphor from *Dryobalanops* (Dipterocarpaceae).

Perhaps three species are cultivated for the famous spice that is derived from the bark: *C. cassia*, *C. burmanii*, and the most important species, *C. verum* (often mentioned under the synonym, *C. zeylanicum*). However, some of the wild species are even more pungent than the cultivated trees and are much sought after locally. Most species bear cinnamic aldehydes, but others bear in varying proportions eugenol (commercially from cloves - *Syzygium*) and safrol (the odor of root-beer), and camphor. Stem, bark, roots and leaves of the same tree may have different odors.

The common wild species of the Sundaic region, *Cinnamomum iners*, is a forest tree, but also widely planted on streets and parks in Malaya and elsewhere. The exact circumscription of this species is obscure which may have led to confusion over its use as a medicine and spice. While the common Malayan and Indonesian tree has little odor in the bark, the species is the claimed source of a bark formerly sold in markets in Mindanao.

The cultivated species have become dangerous invasive species in many regions outside of Asia, especially in oceanic islands.

☞ - *Litsea* Group - ☞

The group is distinguished by the inflorescence, by molecular evidence and the dioecious condition which is prevalent among Asian species.

LITSEA. [From *li-tse*, a Chinese name for *Litsea chinense*.] Be careful not to confuse the name with *Litchi* (Sapindaceae). The number of species is uncertain, maybe 200, a few species in the Americas, but especially Asia to Australia, 11 in Laos, 35 in Thailand, 69 in Malaya, 35 in the Philippines. *Lindera* differs from *Litsea* in two-celled versus four-celled anthers. As with most of the *Litsea* Group, the flowers are unisexual, the trees dioecious.

These are among our most common laurels of the forest understory and lower canopy. Although the genus is too poorly known to be formally divided, one can easily see several types of *Litsea*.

One common type of *Litsea* is represented by *L. oppositifolia*, a small tree of the forest understory with strictly opposite leaves, pinnate venation, and a somewhat whitish lower leaf surface. The flowers and fruit are axillary and sessile.

Litsea magnifica is a small tree of the forest understory in the Sundaic Region. It bears large oblanceolate leaves in a spiral cluster. The flowers are borne from warty knobs on the side of the small trunk.

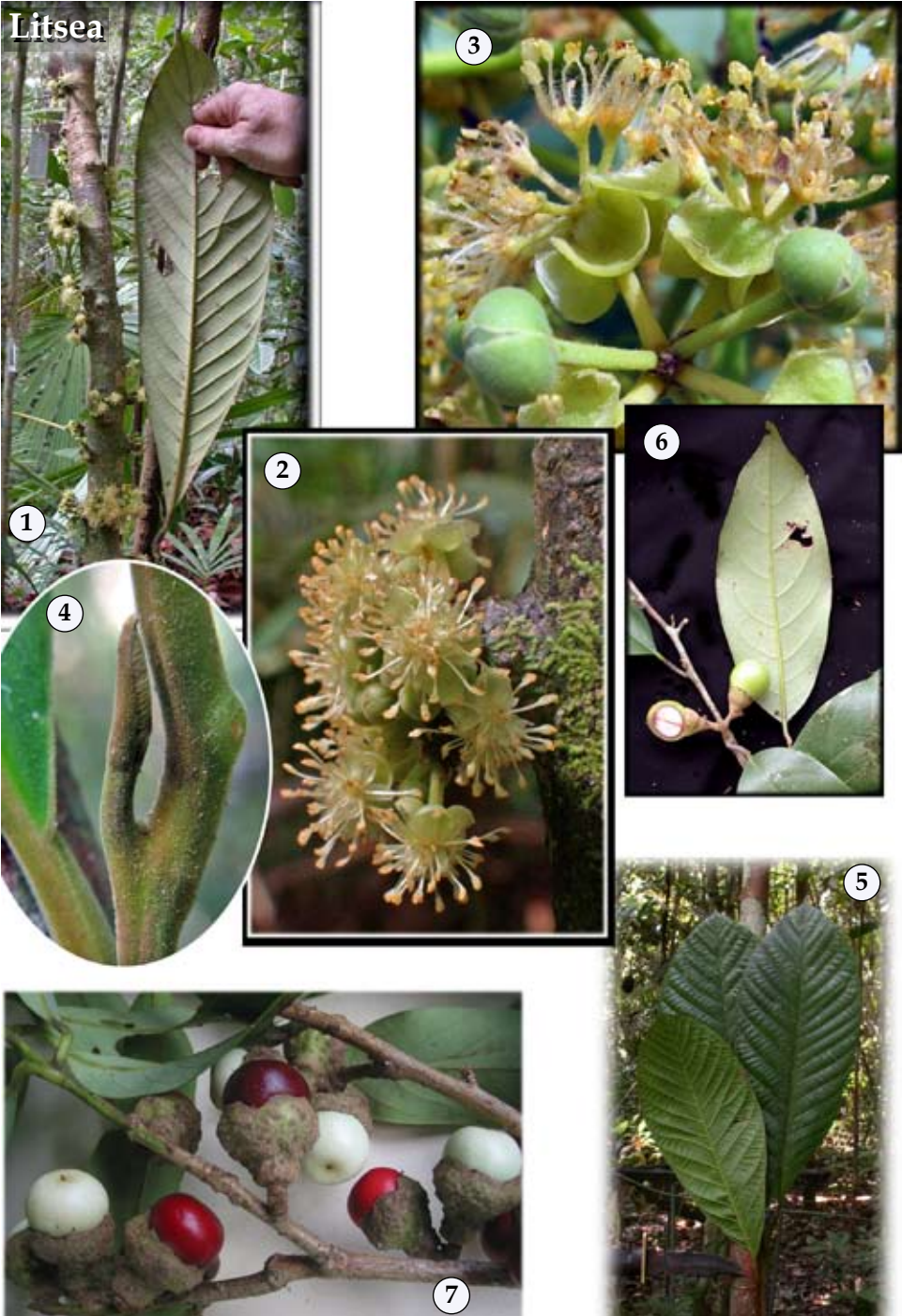
Litsea glutinosa is one of the most widespread of Asian Lauraceae, found from India and Sri Lanka eastward to the Pacific, but not really in the Sundaic Region, known in Malaya in a variant form from a single collection on limestone. It is also unusual among Lauraceae in that it grows well in secondary forests; in the Philippines, where it is called *puso-puso*, it has become exceedingly abundant in recent years. It is regarded as useful in traditional medicine.

Litsea castanea and *L. firma* are a pair of related species that reach fairly large diameters for the genus, but never a very great height. They bear spirally arranged leaves that dry dark brown or coppery gold. While a legitimate part of the lowland equatorial forest, they also do well in late secondary forests.

Litsea cubeba is one of the better known species of southern China and is common on open hillsides southward throughout Mainland SE Asia and then scattered in variant forms southward and eastward. In Mainland SE Asia, it is typically deciduous and blooms when leafless. As with so many Lauraceae, the pungent leave are collected for medicinal oils. The details of the flower are illustrated in THROWER *loc. cit.*

ACTINODAPHNE. [Greek, ray-laural, in reference to the diagnostic whorl of leaves.] Probably over-described at 100 species of tropical Asia, from India to Taiwan, 20 in Malaya, six in the Philippines; about half of the species are known from only one or two collections. Nonetheless, even those species thought to be rare might be locally abundant. Species of *Actinodaphne* are consistent elements in all evergreen forests from lowland to mountains.

The Malay name, *medang payong* or umbrella laurel, is appropriate and well applied because the leaves are in discrete whorls separated by long leafless internodes. At the twig apex, small leaves are clustered like stipules, protecting the apical bud. Most species are of small or medium stature; a few may reach the canopy. The flowers are unisexual, plants dioecious, anthers introrse and four-celled, the drupe on a cup-shaped perianth tube. Just about every *Actinodaphne* you might find will have that same appearance; however, there are evidently a few species placed in the genus that do not have the whorled leaves, and a few have nearly three-nerved blades.



Litsea. 1-2, possibly new cauliflorous species from Sarawak, similar to *L. magnifica* which is usually credited only to the Malay Peninsula; 3, staminate inflorescence of *L. glutinosa*, Philippines, note that what appears to be a floral bud is an inflorescence, bracts cover a cluster of staminate flowers, each with a short floral tube and nine stamens; 4-5, *L. castanea*, Malaya; 4, the twig apex typical of the family; 5, large leaves of the juvenile; 6, an unidentified mountain *Litsea* from Vietnam, the fruit with a swollen base and stalk, the single seed slightly violet; 7, fruit of *L. urdanetensis*, Philippines, with warty cupule, fruit white maturing red. (Photograph 3, © Ulysses Ferreras, 7, © Leonardo L. Co).



Litsea garciae, one of the few edible fruits of the Lauraceae of Asia, endemic to Borneo, called *enkala* in Iban, the fruit must be boiled, the flesh then has the texture of ripe avocado, buttery and flat.

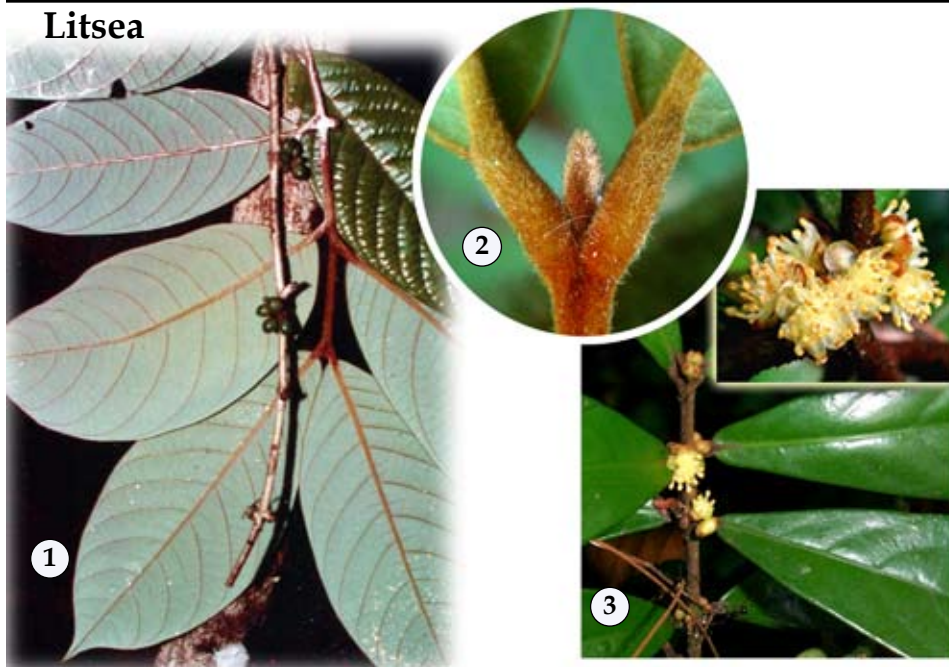
NEOLITSEA. [Greek, near *Litsea*.] Perhaps overdescribed at 85 species from India to Australia with 35 endemic in China, most of these distinguished by fine details of leaf shape. We find six in Malaya, about the same in Borneo and seven in the Philippines. Similar to *Litsea* in the unisexual flowers, but the blade is three-nerved, the leaves spirally arranged and loosely clustered. Male flowers: six stamens in three whorls, only those of 3rd whorl glandular, anthers four-celled; female flowers with six staminodes. *Neolitsea oblongeolata* is one of the more



Litsea glutinosa, adapted from BLANCO *loc. cit.*

important large laurels of Mainland SE Asia. The population ecology is described for the 50-ha plot in Huai Kha Khaeng (BUNYAVEJCHEWIN *loc. cit.*)

Litsea

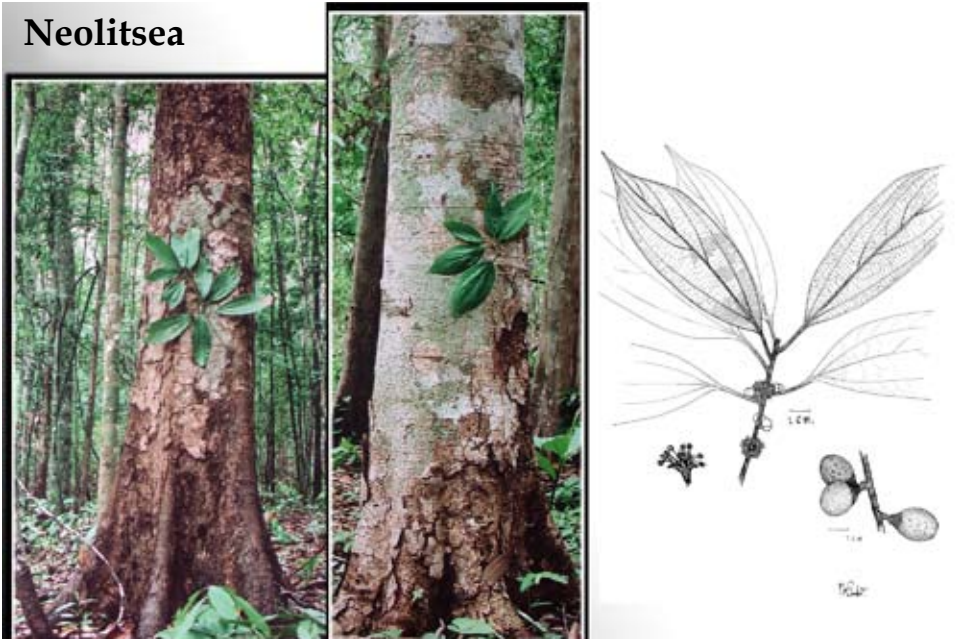


Litsea. A group of *Litsea* in Asia, possibly a clade, are small trees of the forest understory that bear opposite leaves, often glaucous white below with axillary clusters of flowers. 1-2, *L. oppositifolia*, Sarawak; 1, with immature fruit, the mature fruit sometimes to 2 cm across; 2, the twig apex; 3, *L. fulva*, here from the Philippines. (3, © Leonardo L. Co).



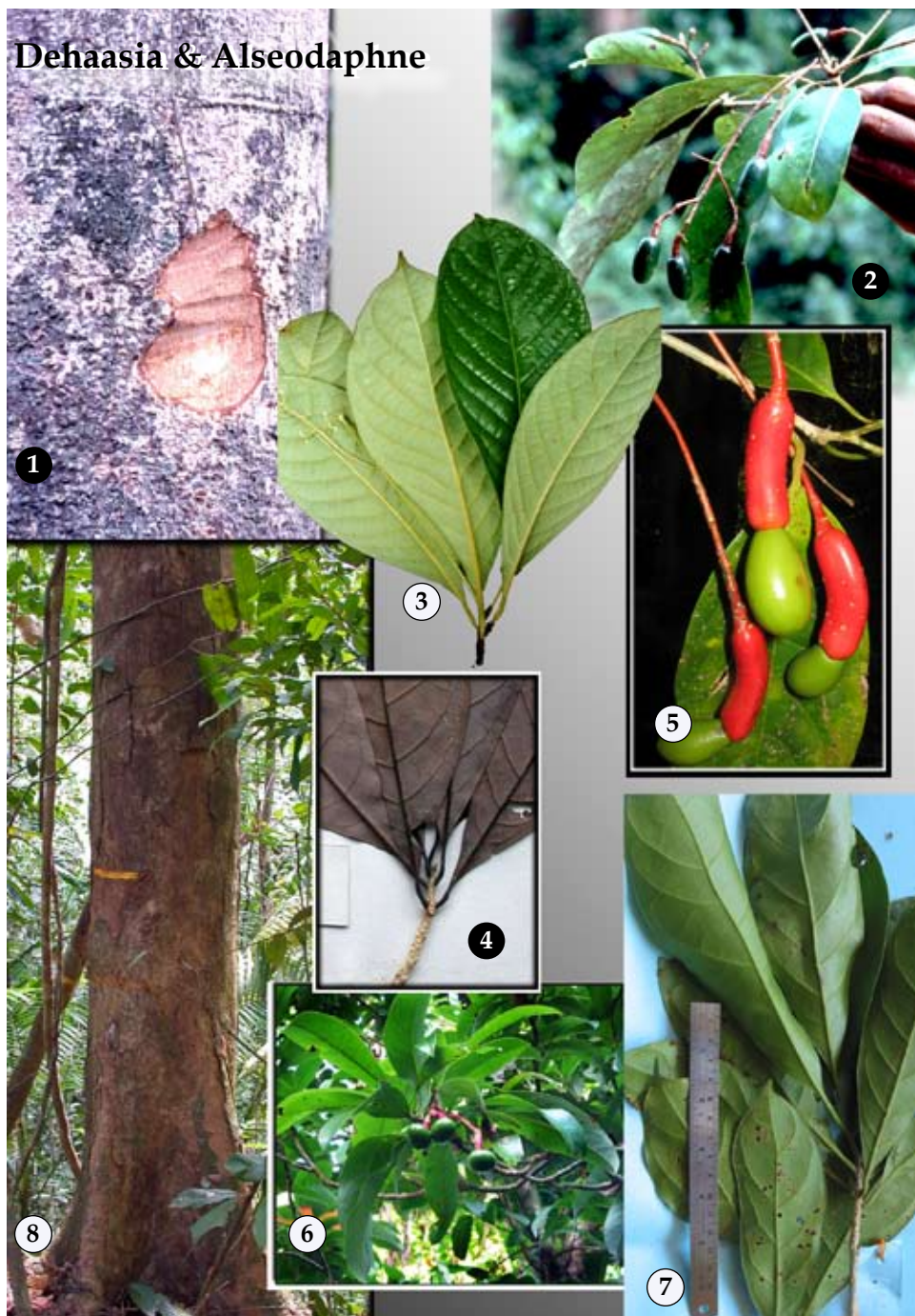
Actinodaphne. 1-2, *A. pruinosa*, Malaya; 1, the leaves in discrete whorls, the blades elliptic, pinnately nerved, glaucous white below; 2, the stalk is tapered to the apex, some species with clusters of scale leaves at each whorl; 3, *A. maingayi*, from Sarawak, with a matted feltish lower leaf surface, the fruit short stalked, note that the fruit are evidently derived from buds axillary to undeveloped and spirally arranged leaves on the leafless portion of the twig; 4, *A. sphaerocarpa*, Lambir, 42 cm DBH, inset of the dry leaf; 5, an undetermined species of *Actinodaphne* from 1800 m elevation in the Central Highlands of Vietnam.

Neolitsea



Neolitsea. The genus is characterized by more or less 3-nerved leaves, but spirally arranged, and flowers as in *Litsea*, although staminate flowers with 6 stamens; shown is *N. oblanceolata*, a common and abundant species of semi-evergreen forest in Mainland SE Asia, here in Thailand, line drawing and two examples of the mature tree showing the variation in bark, which is smooth and gray when young, but later becomes brown and flaked in large plates; (Line drawing from BUNYAVEJCHEWIN *loc. cit.*)

Dehaasia & Alseodaphne



Dehaasia & *Alseodaphne*. Most of these many species bear leaves spirally arranged in loose clusters, somewhat obovate, with a relatively long and tapered leaf stalk; 1-2, *D. cuneata*, Malaya; 1, bark and wood typical of the family; 2, the immature fruit with a somewhat swollen fruit stalk, typically of contrasting color to the mature fruit; 3, *D. firma*, Sarawak, with a long sparsely-flowered inflorescence along the leaf to the left; 4, dry specimen of *D. caesia*, Lambir, with characteristic black stalks and white tip; 5, *D. incrassata*, Bataan, Philippines, with the bright red swollen fruit stalk; 5, *Alseodaphne elongata*, from Palanan, Luzon Philippines, a species of the lower canopy; 6, *A. elliptica*, Palanan, Philippines; 7, *A. malaboonga*, Philippines, with loosely spiral leaves; 8, *A. insignis*, Sarawak, 50 cm DBH. (Photograph 5 © Ulysses Ferreras; 6, 7 © Leonardo L. Co.)



Phoebe. Left, *P. grandis* from Lambir, Sarawak; right, *P. paniculata*, adapted from WIGHT loc. cit.

LINDERA. [Commemorates Johan Linder, d. 1724, Swedish botanist and physician, author of Swedish Flora, *Flora Wiksbergensis*.] 100 species with a global distribution, about 12 in Malaya, two in Philippines, one in Australia. These are multi-branched shrubs and small to medium trees, especially of montane forests where they can become gregariously abundant.

The leaves are pinnate nerved, or with three basal nerves, the arrangement mostly spiral but in a few sub-opposite to opposite. The inflorescence is of one to six flowers in small umbels, each umbel enclosed in two to four bracts, and either stalked or sessile in axillary clusters.

Stamens number nine or 12, the inner one or two rows with glands, the anther two-celled and introrse and so evidently differs from *Cinnamomum*.

CINNADENIA. [Greek, in reference to Cinnamomum and glands of the androecium.] Two poorly-known species of Asia, both are medium-sized trees with narrow elliptic leaves, pinnately nerved in spiral clusters. The flowers are unisexual (dioecious) borne below the leaves in lax open inflorescences. *Cinnadenia paniculata* is not uncommon in Southern China and northern Mainland SE Asia, on open hillsides. *Cinnadenia malayana* is known only from a few locations in central Malaya.

☞ - *Persea* Group - ☞

The genera in the avocado group are particularly difficult to separate, which is a shame because the group includes several important trees. Among our species, almost all bear pinnately nerved leaves, the large open inflorescences as described above, the flowers bisexual with 9 fertile stamens. The *Persea*

relatives are usually segregated as follows: the tepals persistent and clasping the base of the fruit - *Phoebe*; tepals persistent and spreading or reflexed - *Machilus*; tepals deciduous in fruit - *Persea*. Here, I leave *Machilus* as a synonym of *Persea*; additionally, about 15 regional species under *Nothaphoebe* can be referred to either *Alseodaphne* or *Persea*.

ALSEODAPHNE. [Greek for forest-laurel.] Perhaps 50 species, distributed from Yunnan south and east, 25 in Malaya, four in the Philippines. Unisexual flowers, three-merous; perianth lobes six sub-equal – outer smaller than inner – nine fertile stamens, third whorl with glands, short filaments (shorter than the four-locule anthers), fruit stalk swollen, colored, warty. Most of our common *Alseodaphne* the leaves are clumsily alternate in a plane and the flowers with anthers of four cells; most of common *Dehaasia* the leaves are in upright clusters and the flowers are with anthers of two cells.

DEHAASIA. [Commemorates Dirk de Haas, 1691 Dutch Governor of Ambon, Indonesia, patron of sciences.] About 35 species, China, Mainland SE Asia (one in Laos), eastward nine in Malaya, nine in Borneo. Most are medium trees 25 to 30 m tall, Twigs mostly white, leaves in clusters, lvs generally dry black, nerves looped, terminal bud with several adpressed scale-leaves; outer tepals much smaller than inner, the filaments broad and variably longer or shorter than the two-locular anthers, perianth persistent in fruit and/or fruit stalk swollen and colored, typically the fruit thin black flesh, and the stalk bright red. anthers two-celled.